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B26D 7/26

(52) UK CL (Edition O)
B4B B22S1

(56) Documents Cited
GB 2039813 A GB 1505052 A GB 1319996 A
GB 1042985 A GB 1042984 A US 4502357 A
US 4098173 A

(58) Field of Search
UK CL (Edition O) B4B , B5D DP
INT CL^6 B26D 1/14 1/143 1/22 3/12 5/00 7/26 , B31B 1/14 1/18 1/20 1/22

(54) Rotary slotting device

(57) A slotting device for a linear succession of moving sheets, being part of a creasing and slotting machine, with arcuate knives 10, 11 being mounted separately on a pair of rotating knife gears (9, 8, Fig 3b) each driven independently about a common axis by a pair of gears 15, 14 rotatably mounted on a pair of driveshafts 17, 16 driven by computer-controlled motors. The knives may be accelerated and decelerated independently to assume instantaneous positions relative to each other and to a sheet to be cut, in order to determine the length and spacing of successive cuts. The knives may be mounted on a common axis as illustrated or on separate axes spaced apart along the line of travel of the sheets.

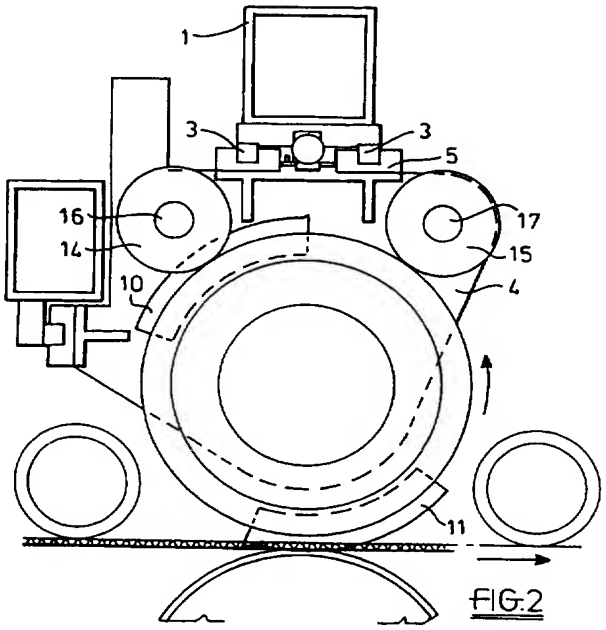

FIG.2

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

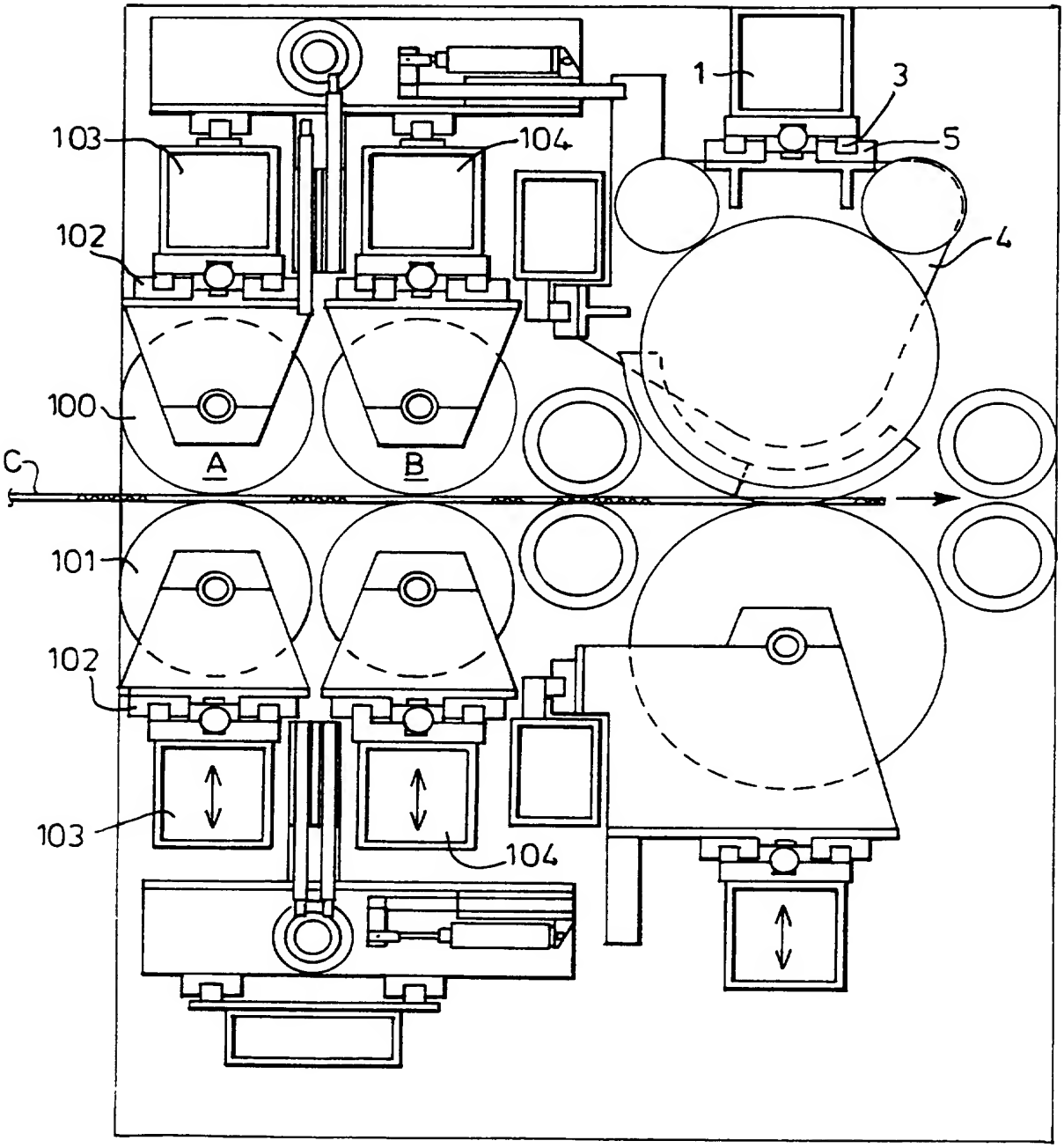


FIG.1

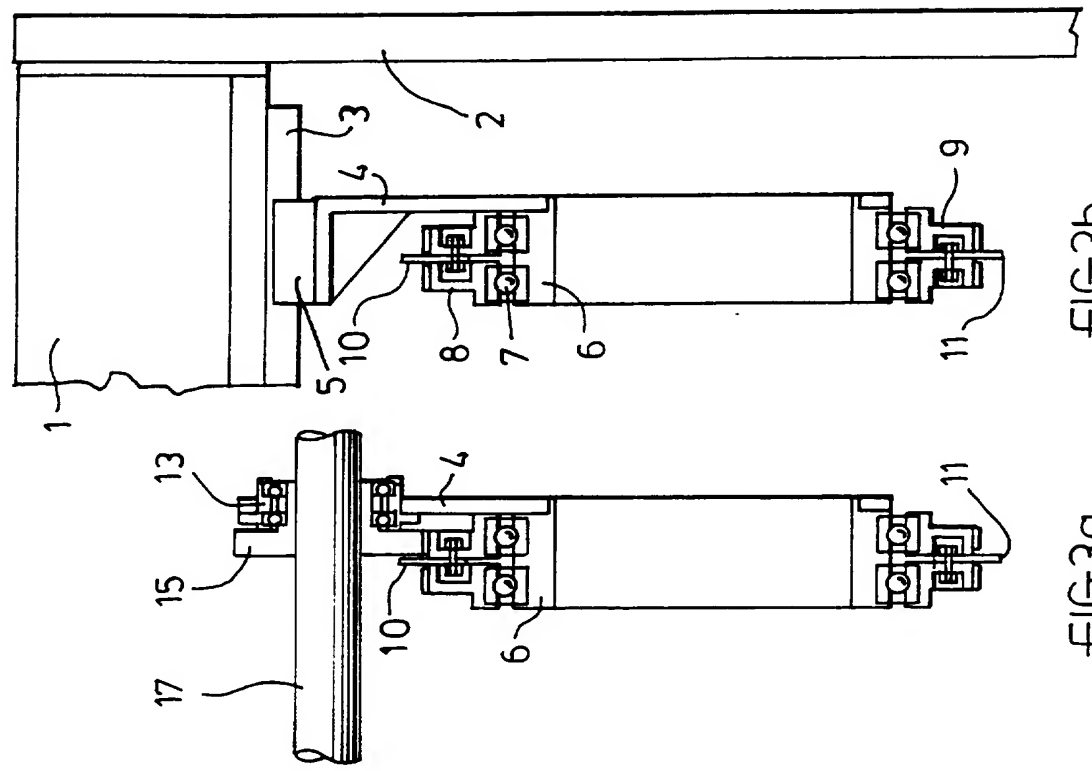


FIG.3b

FIG.3a

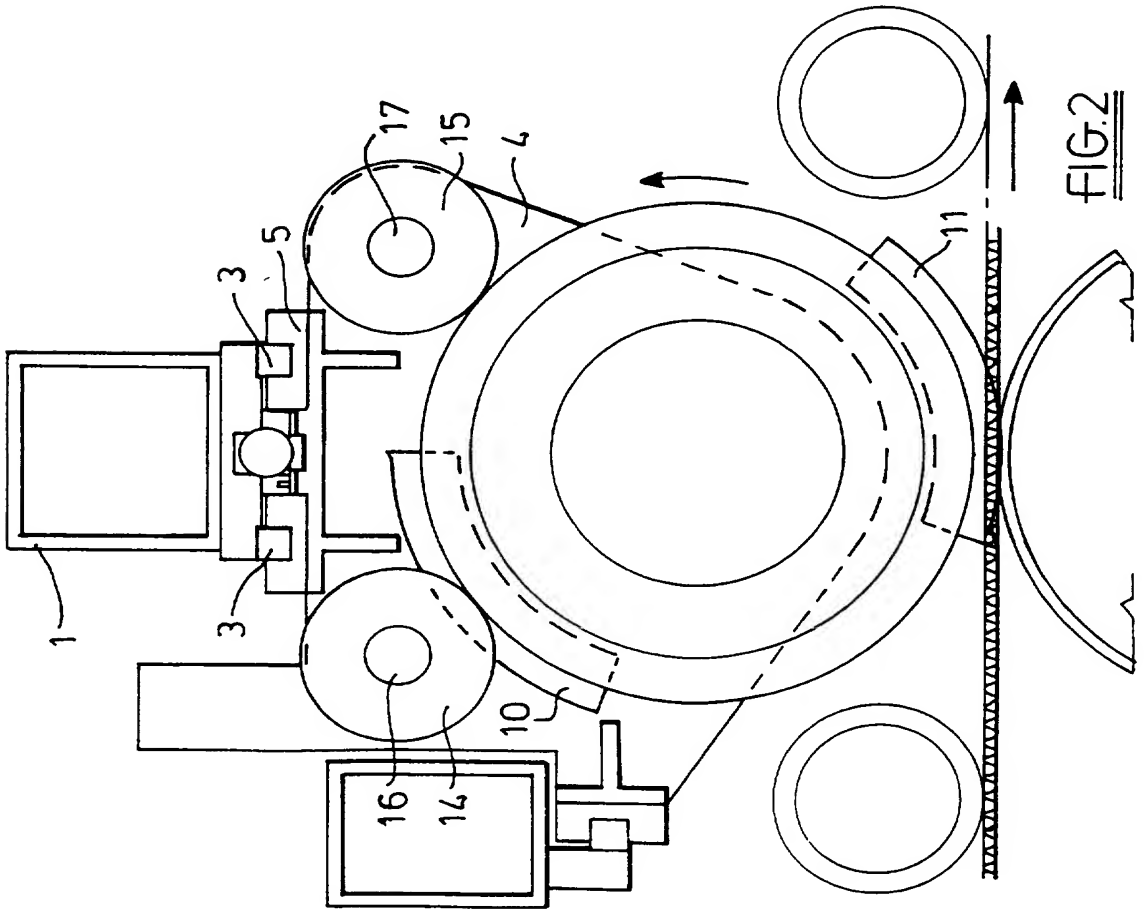
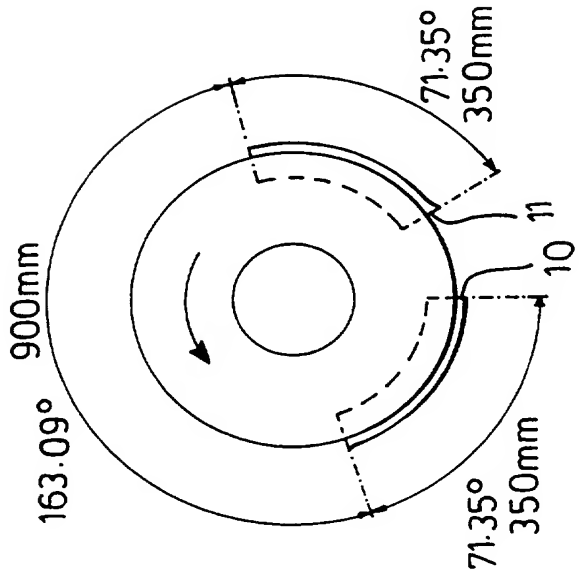


FIG.2


71.35°
350mm
11
10
900mm
163.09°
71.35°
350mm

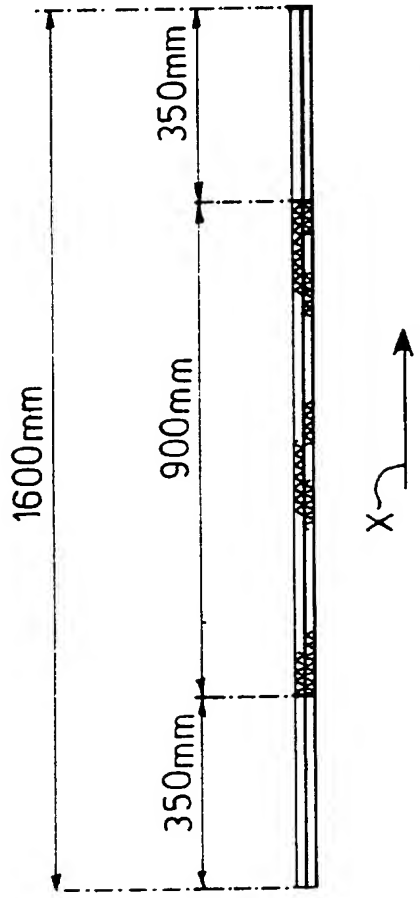

350mm
1600mm
900mm
350mm
X

FIG.4

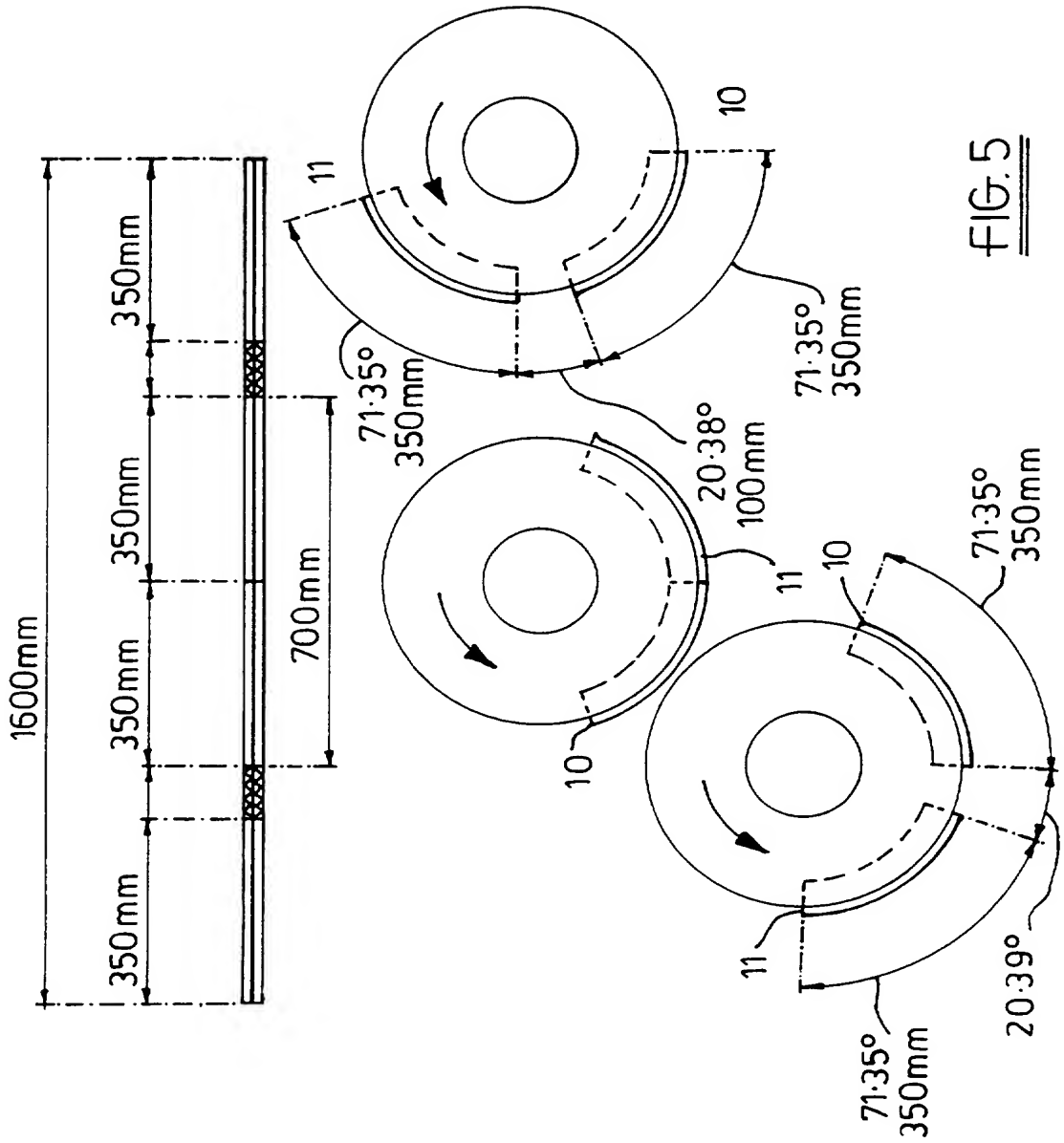

1600mm
350mm
350mm
350mm
350mm
700mm
11
10
71·35°
350mm
20·38°
100mm
20·39°

FIG. 5

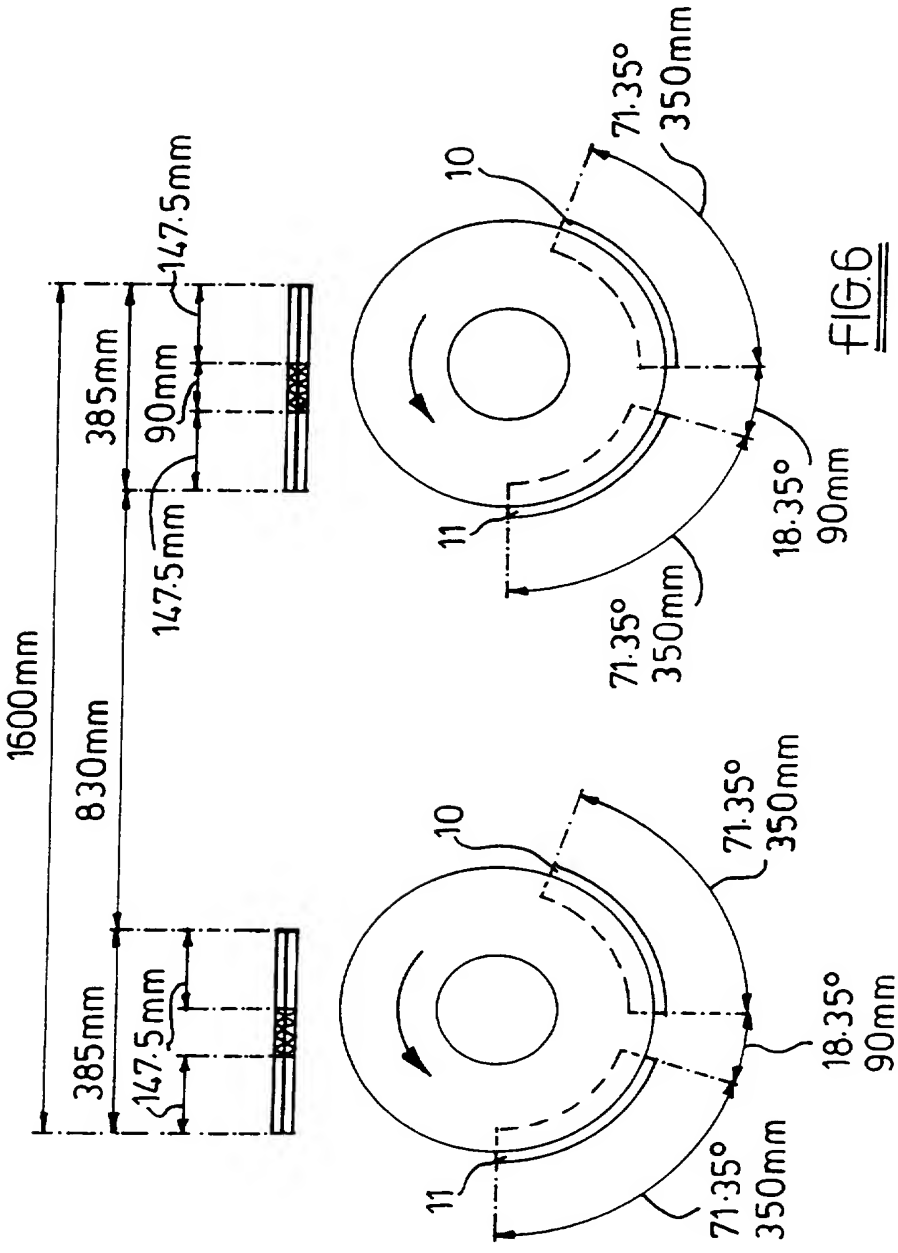

1600mm
830mm
385mm
147.5mm
385mm
147.5mm
90mm
147.5mm
10
11
71.35°
350mm
71.35°
350mm
18.35°
90mm
10
11
71.35°
350mm
71.35°
350mm
18.35°
90mm

FIG6

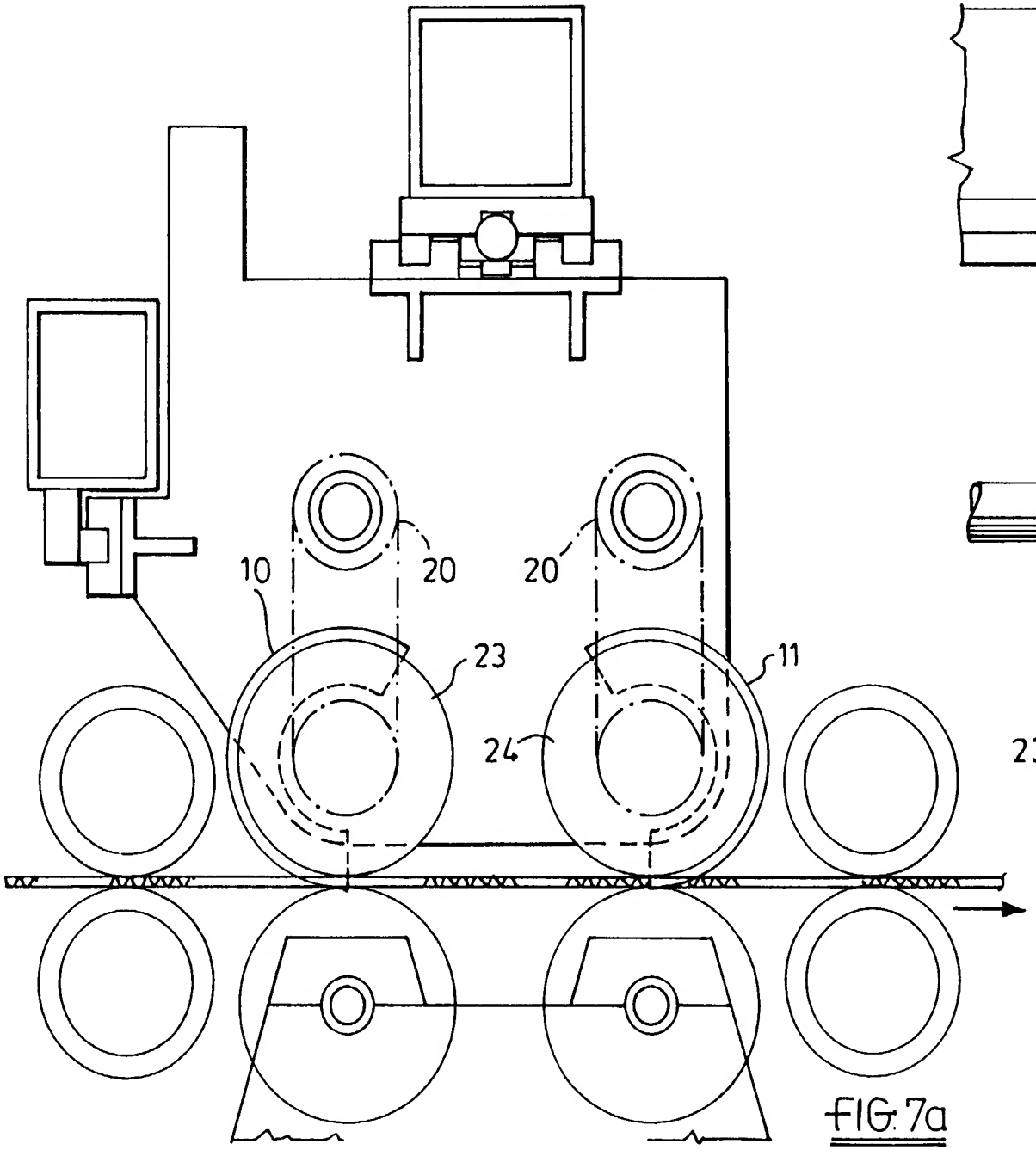


FIG. 7a

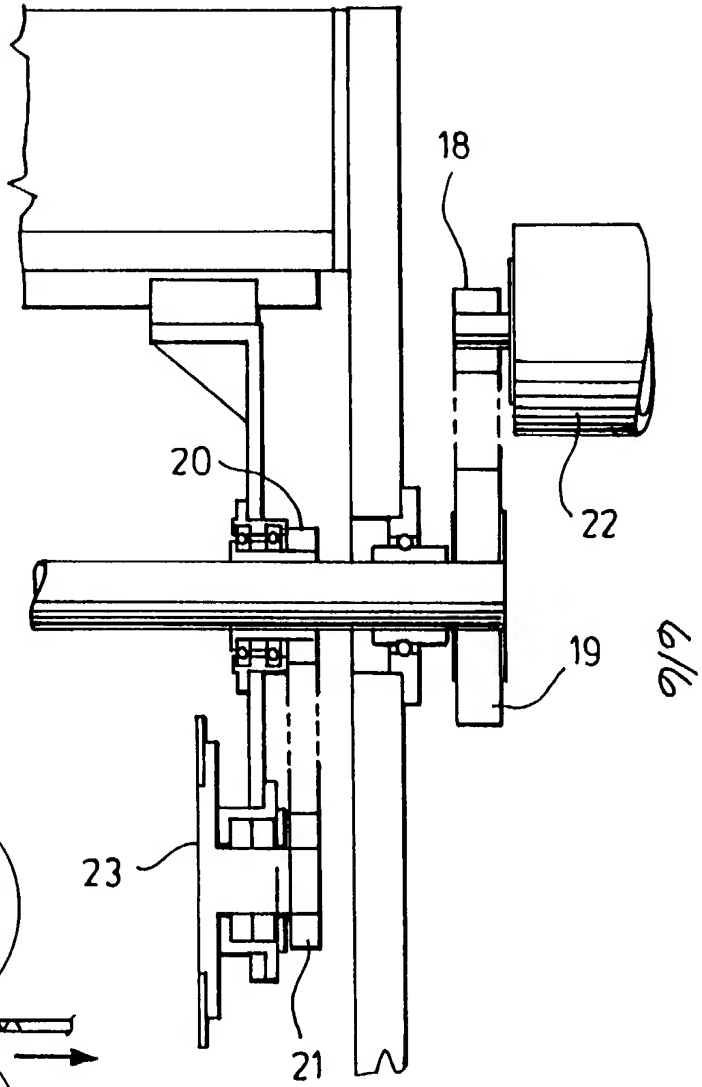


FIG. 7b

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ROTARY SLOTTING DEVICE

THIS INVENTION concerns a device for cutting slots in a linear succession of moving sheets or boards. Such devices are commonly used in the manufacture of corrugated boxes to produce linear slots in flat cardboard blanks for the subsequent folding and glueing of the blanks to produce boxes.

A slotting device of this kind is usually provided in conjunction with a rotary creasing device which scores or produces linear indentations in the board to enable it to be folded easily, again for the production of finished boxes.

In a typical machine there is provided a rotary creasing head forming, with an anvil, a nip between which boards are successively fed thus to produce a continuous crease along each board at the desired position across the width of same. A pair of driven pull rolls are provided within the machine to ensure that the board is transported therethrough at a substantially constant velocity. In the direction of travel of the board there then follows a rotary slotting head which carries around a part of its circumference an arcuate knife which, by interaction with an anvil roller beneath the board, cuts slots in the board as it travels through the machine after being creased. Further pull rolls are usually provided after the slotting head, again to ensure positive transport of the board through the

machine.

At the slotting position it is usual to provide a pair of slotting knives extending arcuately around a part of the driven slotting head so as to perform slots at spaced positions along the board as it travels through the machine.

Conventionally, one of the knives is fixed to its associated head whilst the other may be adjusted in position around the circumference of the head thus to determine the length of and spaces between the slots.

Adjustment of the position of the thus movable knife has been provided in the past by one or more fixing nuts which may be released to permit the knife to move around the head, and then re-tightened when the knife is in the selected position.

In an improved arrangement, the moving or adjustable knife is mounted on a gear ring which meshes with a pinion usually driven from the adjacent creaser driveshaft.

In a typical creasing/slotting machine several sets of creasing and slotting heads are adjustably mounted on transverse shafts or beams so as to perform several creasing and slotting operations simultaneously across the width of a board as it travels through the machine.

In the slotting operation the selection of length and

spacing of slots is limited by the constraints imposed upon the degree of available adjustment of the adjustable knife relative to the fixed knife, and the speed at which the relative positions of the heads can be adjusted.

In all cases, compensator means must be provided to ensure that the fixed knife and therefore the movable knife positioned selectively in relation thereto, engage and cut the board at required register positions thereon.

A considerable advantage can be obtained by providing a device in which both cutting knives are adjustable, each with respect to the other, and preferably during a production run.

There is therefore provided, according to the present invention, a device for cutting slots in a linear succession of moving sheets, comprising at least two arcuate knives adapted for rotation about at least one axis transverse to the direction of movement of the sheets as the sheets successively pass a position radially displaced from said rotational axis; characterised in that both knives are adjustable in their relative rotational positions during rotation thereof.

Preferably each knife is independently driven around its rotational axis and is capable of acceleration and deceleration thus to assume an instantaneous position relative to the sheets and to each other in order to determine the length and spacing of successive slots.

In one preferred embodiment, the knives are adapted for rotation about a common axis and separately mounted each upon a non-rotating hub, rotational movement of each knife about the common axis serving to perform the cutting operation and successively to position the knife for a subsequent cut.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:-

Fig. 1 is a schematic side view of a creasing and slotting machine including a cutting device made in accordance with a first embodiment of the invention;

Fig. 2 is an enlarged and further detailed view of the cutting device;

Figs. 3a and 3b are schematic and part fragmentary side views of the cutting device;

Figs. 4, 5 and 6 are diagrammatic representations of the operation of the cutting device as adapted and adjusted to perform several different slotting operations.

and Figs. 7a and 7b are views similar to Figs. 2 and 3b of a second embodiment of the invention;

Referring now to the drawings, the machine to be

described consists essentially of two creasing heads A and B each forming, with an anvil, a nip through which successive boards C pass in a linear horizontal direction whereby continuous creases are performed on the board.

Each creasing head more specifically comprises a rotary creasing head 100 acting on one face of the board and a rotary anvil 101 forming the nip for receipt of the board. Each creasing assembly of head and anvil is mounted on a carriage 102 which is linearly movable across the machine on cross beams 103, 104. Several such creasing assemblies are provided across beams 103, 104 thus to select or deselect a creasing function at predetermined positions across the board.

The creasing assemblies form no part of the present invention save for their inclusion in a combined creasing and slotting machine and so a further description of detailed parts of the creasing section is unnecessary.

Referring now to the right-hand part of the assembly in Fig. 1 and to Figs. 2, 3a and 3b, there can be seen a cross beam 1 extending between a pair of side frames one of which is illustrated at 2, and positioned at opposed sides of the machine.

This description will refer to the detailed construction of a single slotting head although several such heads, like the creasing heads, will be provided to occupy several positions across the machine

thus simultaneously to perform several slotting operations across the width of the board.

Mounted on a rail 3 by way of a suspended running block 5 is a head support bracket 4.

Fixed to the head support bracket 4 is an annular hub 6 on which two ball races 7 are mounted. The ball races 7 support a pair of side-by-side coaxial knife gears 8 and 9.

A first arcuate knife 10 is fixed to the knife gear 9 and a second arcuate knife 11 is fixed to the knife gear 8. The knife gears 8 and 9 are thus rotatably mounted independently on the hubs 6.

Also mounted on the head support bracket 4 in bearing assemblies 13 are drive gears 14 and 15 drivingly connected to and mounted upon drive shafts 16 and 17 respectively. The gears 14 and 15 are in driving mesh with the knife gears 8 and 9 respectively. Drive is transmitted from the shafts 16 and 17 to gears 14 and 15 by key ways or other similar arrangements such as square or hexagonal drive shaft formations. The drive gears 14 and 15 are designed so that they may slide along the drive shafts to allow setting of the transverse position in the machine of each slotting assembly.

The two drive shafts 16 and 17 are driven independently by computer controlled motors.

In operation, each slotting head is operated selectively to cut slots in the successively advancing boards at predetermined positions therein. Thus, as illustrated in Fig. 2, the second knife (No. 2) is about to complete cutting a slot in the board over a distance of some 40° of rotational movement. This is followed by progression of the board unslotted until the leading edge of the first knife (No. 1) penetrates the board and cuts a slot equivalent to the arcuate length of the knife, thereafter leaving a further unslotted length.

It will be seen that by selectively driving first and second knives independently of one another to predetermined instantaneous positions, the location and extent of the slots can be determined.

For simplicity, the knives are shown in Fig. 1 as mutually abutting thus to provide a single elongate slot during each revolution of the pair of knives.

Referring now to Fig. 4 which diagrammatically illustrates the cutting operation as determined by the relative positions of the first and second knives and shows the actual cuts performed on the board, it will be seen that a board having a length of 1600mm is advanced through the machine in the direction of arrow X and at the instantaneous position of the rotary head illustrated the first knife would perform a cut of 350mm in length, and thereafter, since the second knife is positioned with its leading edge 180° displaced from the trailing edge of the first knife, an uncut length of

board of 900mm follows. This is then followed by a further cut of 350mm performed by the second knife. After the second knife has completed its cut the leading edge of the first knife must be moved, if necessary, to bring its leading edge into bottom dead centre position to penetrate the next successive board at its leading edge, once again to perform the same cuts in the next board.

Preferably, both knives are accelerated and decelerated and moved around the common axis at different speeds as necessary to bring them into their required positions to perform the cuts. These movements performed via the mechanism illustrated in Figs. 2 and 3, are effected by appropriate computer controlled operation of the drive motors coupled to the drive shafts 16 and 17.

Referring now to Fig. 5, it will be seen that it is possible with the arrangement of two knives independently driven, to cut two successive boards in abutting relationship. In other words, pairs of boards (double feed) are fed through the machine with their mutually adjacent trailing and leading edges in abutting relationship.

Thus, it will be seen that at the right-hand side of Fig. 5 the first knife from bottom dead centre performs a cut equivalent to 350mm in length. A gap is left between the trailing edge of the first knife and the leading edge of the second knife equivalent to a linear distance of 100mm so that an uncut length of board of that length remains. Immediately afterwards, the second knife commences its 350mm cut and before the trailing edge of the second knife has completed its cut the leading edge of the first knife is driven around

the axis into abutting relationship with the trailing edge of the second knife as illustrated beneath the adjoining section of the boards.

After the trailing edge of the first knife has left the second board the second knife has again been driven around the axis to leave a further 100mm length of uncut board before it performs the final 350mm cut at the trailing edge of the second board, with the result that two boards have been cut in what is essentially a single operation performing for each board a pair of slots each of 350mm length extending inwardly from opposed edges with 100mm uncut portions centrally disposed.

Referring now to Fig. 6, in a further example of "double feed" two boards are fed through the machine with a predetermined distance between them of 830mm, the overall distance from the leading edge of the first board to the trailing edge of the second board being 1600mm. In this arrangement, a trailing part of the first knife performs a cut of 147.5mm in the leading edge of the first board with the second knife spaced behind the first knife in the direction of rotation by a distance of 90mm thus to leave an uncut portion of the board of that length. The leading half of the second knife then performs a further cut of 147.5mm as far as the trailing edge of the first board. During the time interval in which a distance of 830mm (the space between the boards) is travelled, the leading edge of the first knife has passed the bottom dead centre and the knife penetrates the leading edge of the second board approximately half way through its arcuate extent thus again performing a half cut

of 147.5mm, and once again the second knife is positioned behind the first knife by a distance equivalent to 90mm to leave a further uncut portion of that length, and finally, the leading portion of the second knife performs the final cut on the trailing edge of the second board.

Although the slotting mechanism in accordance with this invention has been described as comprising a plurality of annular hubs around which knife bearing gears are driven selectively to determine the position and extent of each cut, in an alternative arrangement the hubs may be provided in the form of annular heads mounted upon a fixed or rotating shaft provided that each knife gear is adapted to be driven independently of the other and of the central shaft to the desired positions as determined by the cuts to be performed.

However, the preferred arrangement of annular hubs mounted on the head support brackets 4 provides a much lighter construction when compared with conventional cutting systems, and the combined adjustment and cutting motion of the knives reduces the number of separate drive systems required.

Referring now to Figs. 7a and 7b, in an alternative embodiment the first and second knives may be mounted on individual holders 23 and 24 respectively, disposed in spaced apart relationship along the line of travel of the boards, as opposed to being mounted on a common axis as in the first embodiment described above.

As can be seen from Fig. 7b each of the knife holders 23 and 24 is driven by an assembly of timing belts and pulleys 18, 19,

20 and 21 from a computer-controlled motor 22. In place of the timing belt assembly a gear train may be used if preferred. In the example illustrated in Fig 7a a leading slot has been cut in the board by the second knife, and the first knife is about to commence cutting a trailing slot. In this condition the second knife can be re-positioned ready to cut the leading slot in the next succeeding board.

If preferred, the knife holders 23 and 24 in this embodiment may be placed directly upon re-positioned drive shafts 16 and 17 thus eliminating the need for timing belts or gears.

CLAIMS

1. A device for cutting slots in a linear succession of moving sheets, comprising at least two arcuate knives adapted for rotation about at least one axis transverse to the direction of movement of the sheets as the sheets successively pass a position radially displaced from said rotational axis; characterised in that both knives are adjustable in their relative rotational positions during rotation thereof.

2. A device according to Claim 1, wherein each knife is independently driven around its rotational axis and is capable of acceleration and deceleration thus to assume an instantaneous position relative to the sheets and to each other.

3. A device according to Claim 1 or Claim 2, wherein the knives are adapted for rotation about a common axis and separately mounted upon a non-rotating hub, such that rotational movement of each knife about the common axis serves to perform the cutting operation and successively to position the knife for a subsequent cut.

4. A device according to Claim 1 or Claim 2, wherein each knife is mounted on a knife support, two or more of said supports being independently rotatable side-by-side on an annular hub.

5. A device according to Claim 4, wherein each knife support carries one part of a gear assembly another part of which is drivingly connected to and mounted upon one of at least two motor-

driven shafts such that said knives may be driven independently and selectively by said motor driven shafts.

6. A device according to Claim 5, wherein each of said motor-driven shaft is driven independently by an associated computer controlled motor.

7. A device according to Claim 1 or Claim 2, wherein each knife is mounted on an annular head itself mounted on a rotating shaft.

8. A device according to Claim 1 or Claim 2, wherein said at least two arcuate knives are mounted on individual holders for rotation about separate rotational axes disposed in spaced apart relationship along a line of travel of the moving sheets.

9. A device according to Claim 1 or Claim 2, wherein each knife is driven by an assembly of timing belts and pulleys connected to an individual computer-controlled motor.

10. A device according to Claim 1 or Claim 2, wherein each knife is mounted directly upon a driveshaft connected to a computer controlled motor.

11. A device according to any preceding claim, wherein each knife is rotatably mounted on a knife holder and is adjustable therewith along its axes of rotation thus to select a transverse

position across the device at which slots may be cut in sheets moving at right-angles thereto.

The Patent Office

15

Application No: GB 9614333.4 **Examiner:** Hal Young
Claims searched: 1-11 **Date of search:** 23 September 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B4B ; B5D(DP)

Int Cl (Ed.6): B26D(1/14, 143, 22; 3/12; 5/00; 7/26) ; B31B(1/14, 18, 20, 22)

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB2039813 A	(DERITEND) see figs and claims.	1-3,7,8, 10
X	GB1505052	(S & S CORRUGATED) see figs 1-6 and lines 70-89 of page 1.	1,2,4,7
A	GB1319996	(HENRY) see figs and lines 36-50 of page 1.	
X	GB1042985	(DERITEND) see figs and lines 66-69 on page 1.	1,7,8
X	GB1042984	(DERITEND) see figs and lines 78 of page 1 to line 13 of page 2.	1,7
A	US4502357	(HUSSISSIAN) see figs 1 and 2.	
X	US4098173	(JAMESTOWN) see whole document.	1,7-10

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.